Remarks/Arguments

Claims 1-10 remain in this application. Claims 11-22 have been withdrawn as a result of earlier restriction requirements. Claims 1-10 stand rejected under 35 U.S.C. 103a based on Holland et al. in view of Chumbers et al. Reconsideration of that rejection is respectfully requested based on the following.

The abstract has been revised to shorten it to 150 words.

Claim 1 has been amended by characterizing the substrate as being "non-silicon." This further differentiates the invention from conventional microfluidic devices, such as described in Holland et al,, that rely on a monolithic slab of the semiconductor silicon to function as both the matrix and the substrate for the microfluidic device. Support for this specific expression can be found at page 3, line 12-16.

The method of this invention provides a wholly new way of producing microfluidic devices, particularly for electrochemical uses. Instead of literally carving such devices from a slab of semiconductive silicon (using LIGA or IC processing) as is conventional, the present method involves only simple lamination and photoresist procedures. Using a non-conductive substrate for the device avoids the insulation problems with silicon. Even more importantly, the present process avoids the need to use expensive and pollution sensitive IC processes necessary with a silicon substrate. This can be a critical advantage for the many chemical sensor materials that are incompatible with IC processing. The method may employ large sheets of flexible non-conductive material,

and particularly dry photoresist, both for the substrate and the matrix. This technique is more adaptable to efficient and high yield modular processing. In this method photoresists are employed in a novel manner. They are used not only to produce channels and chambers for the microprocessor package but they are used to form a permanent part of the structure. Negative photoresists are employed in this invention in creating the structure as negative photoresists may be hardened by the light exposure to a durable state.

Turning to the references, Holland et al., of which the present Applicant is one of the inventors, is cited as the principal reference. It discloses a chemical etching method for producing an electrochemical cell in a crystalline slab of the semiconductor, silicon. In this process a positive photoresist layer is placed on the slab surface and then exposed with a desired pattern. It is then developed to provide a mask on the slab surface with openings therein through which the slab is chemically etched in a conventional manner. The remaining photoresist is then removed by chemical dissolution. The slab surface is then subjected to chemical etching through the openings in the photoresist to produce appropriate cavities in the slab. The opposite slab surface is similarly chemically etched by means of another positive photoresist covering that surface. That photoresist is exposed to appropriate patterned light and developed to produce openings therethrough appropriate to produce the cavities desired on that side of the slab. That surface is then chemically etched through those openings to produce the cavities in that side. The remaining photoresist is then removed by chemical dissolution.

It can be seen from the above that the only purpose of the photoresists is their conventional use to provide a temporary surface protection and to isolate the etchant to the open areas in the resist. The resists do not form any structural part of the chemical cell produced.

Chumbers et al. relates to the preparation of a metal conductor clad circuit board having conductor holes therethrough, in a manner that avoids build up of lands on edges of the holes. The holes, to be used for electrical connection between the two sides of the board, are drilled though the circuit board at intervals and the interior surfaces of the holes then clad with metal conductor. A photoresist is placed over one surface of the drilled board and a desired circuit pattern is produced on the resist which includes holes having a diameter no greater than that of the drilled holes.

In a first species the holes and circuit configuration are exposed from the same side using a mask having holes of a diameter smaller than the drilled holes. In a second species, using a positive photoresist, the hole and circuit configurations are exposed from opposite sides of the board. That is, in this species exposure of the holes takes place directly through the holes from the side of the board opposite the photoresist.

In both species an etching resist is then placed over the exposed and developed photoresist and thus in into the circuit pattern openings. The photoresist is then removed and the unwanted cladding material unprotected by the etching resist is then removed by chemical etching.

It can thus be seen that Chumbers et al. is another chemical etching process and its only relevance is the use of photoresists in that process. However, this use is simply in the conventional manner to define the areas for deposit of etching resist preparatory

to chemical etching of the circuit board. The photoresist is simply removed and discarded prior to chemical etching and it not a component if the completed product.

Staats discloses a method of forming microfluidic devices using ink jet fabrication techniques. In this technique a bead of photoresist is deposited on a silicon or glass substrate and the bead is then surrounded and covered with a polymer as a part of the microfluidic device. The resist is then developed (dissolved) to leave the desired channel or reservoir. This technique does not employ a discrete photoresist film which becomes a material part of the finished device. Rather, the photoresist in Staats is dissolved and completely removed.

Possin et al. concerns fabrication of a laminated film semiconductor in which an opaque island structure (electrode) on a non-conductive film substrate (with a semiconductor film between the island and the film). A photoresist film is placed over the island with a non-specular (reflective) layer thereover. The underside of the film is exposed. This directly exposes the photoresist except for the area above the opaque island. Reflection from the non-specular layer above the island will also cause exposure inwardly a distance toward the center of the island, leaving the photoresist layer unexposed only at the center of the island. The exposed photoresist is then removed. The remaining photoresist under the island is then used to for other patterning operations or depositing another layer over the island and then it is also removed. Thus, the photoresist forms no part of the competed product.

Additionally, this reference is for the production of an essentially solid laminate for a wholly different purpose, i.e. semiconductor use.

The foregoing references separately or in combination fail to render the claimed method obvious. Holland et al. is concerned only with silicon and does not disclose or

suggest using a flexible, non-crystalline substrate. The remaining references disclose only crystalline (glass, silicon) or metal coated circuit boards as substrates.

All of the references use photoresists only as temporary layers in a composite and they are stripped therefrom after their function has been fulfilled. There is no disclosure in any of using photoresists as permanent structural components or layer of a completed composite, much less as a layer in which cavities are permanently formed in the composite.

Holland et al. employs only positive photoresists. In this respect the disclosure of Chumbers et al is referenced in the Action as suggesting that negative and positive photoresists may be used interchangeably and that thus that it would be obvious to employ negative photoresists in the claimed process here.

Indeed for some uses a negative photoresist may be substituted for a positive photoresist and vice versa. However, for other uses only one type, negative or positive, may be feasible. For example in the second species of the method of Chumbers et al., itself, only positive photoresists are feasible because of the way the photoresists are used in that species. Similarly, in the novel way that photoresists are used in this invention only negative photoresists are suitable. As taught in this invention photoresists are exposed to light to become a durable permanent structural part of the completed microsensor and negative photoresists were chosen for this particularly as they are hardenable by exposure during fabrication of the microsensor to provide adequate durability. Positive photoresists rather than hardening, are made soluble where they are exposure to light. Thus, if positive photoresists were employed, the unexposed areas of these photoresists in the completed microsensor would be susceptible to degradation by light and exposure to solvents.

Moreover in the preferred embodiment of the invention only negative photoresists are suitable to accomplish the fabrications steps. Referring particularly to FIGS 5-14 and as claimed in claims 5-10, a smaller mask is utilized in exposing the matrix layer and the larger opaque silver layer 13 therebelow acts in turn as a mask for photoresist substrate 11. This would not be possible using a positive photoresist as the area of exposure of the matrix layer could be no larger than the size of the smaller well 19 in the matrix layer.

It can be seen that positive and negative photoresists are by no means equivalents, and that the use of negative photoresists in accordance with this invention.

Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

Respectfully submitted,

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